

California, where killing frosts are rare enough to make the culture profitable in the long run, especially if orchard heating is practiced at critical times. Peaches are raised extensively in the South and on the leeward shores of Lakes Michigan, Huron, and Erie, where killing winter temperatures and frosts after flowering are infrequent. Apples, being hardier, are raised farther north, though in apple culture, valley slopes and leeward (eastern) shores are favored. Pears and cherries are intermediate between peaches and apples.

Live-stock.—Live-stock raising is controlled mostly by rainfall, though the temperature limitations imposed on the distribution of field crops enters also. Hogs thrive where the corn grows; dairy cows are most numerous farther north, where there is the corn silage. Cattle are raised in the general hay and pasture regions, and, in relative importance for the regions involved, hold sway particularly where field crops can not well be raised. In the arid parts of the West the cattle can get some sustenance on the plains and mountains, but the forage (mostly alfalfa) from the irrigated patches must supplement this generally meager and discontinuous supply. In the driest parts, sheep can live where cattle can not.

It is usually obvious that the climate is essentially the basis for the general type of farming at any place. There is the "wet farming" of the eastern half of the country, where the rainfall is generally sufficient for the crops that are to be raised, and where, therefore, the temperature determines what can be raised, and the topography and soil limit the local distribution. The dry farming of the Great Plains and of other parts of the West relies on conservation of what rain there is by limiting evaporation from the soil. In some places, as in eastern Washington, two years' rainfall is needed for one good crop of wheat. The irrigation farming of the arid parts of the West is necessitated by the dryness of the lowlands, but is rendered possible by the rainfall precipitated on the mountains which keep the moisture from reaching the valleys to leeward.

A comprehensive bibliography closes Prof. Ward's paper.—*C. F. B.*

MINIMUM TEMPERATURES SUSTAINED BY APRICOTS DURING MARCH, 1919, IN THE PECOS VALLEY, N. MEX.

By CLEVE HALLENBECK, Observer.

[Dated: Weather Bureau Office, Roswell, N. Mex., May 17, 1919.]

It has been a matter of common observation in the semi-arid and elevated regions of the West that fruit blossoms and other tender vegetation will withstand temperatures that would kill all or nearly all growing vegetation in the lower and more humid districts of the eastern half of the United States. Whether this resistance to cold is due to elevation, humidity, soil, or some unknown factor, or to two or more of these combined, has not been determined, but it seems to be more noticeable when the moisture content of both the soil and the air is low. It has, however, frequently been observed under just the opposite conditions. For example, the apples in the Pecos Valley were, when in full blossom, subjected to a snowstorm lasting 15 hours, during which the temperature was continuously below freezing, and below 30° in portions of the orchard district for several hours. Nevertheless, no noticeable damage was sustained, either to fruit or to young truck crops. This was on April 8, 1919, and the same thing has occurred in previous seasons, having once before (1917) been observed by the writer.

The following data illustrate a remarkable case of resistance to temperatures below freezing after a period of low atmospheric humidity:

| Date. | Minimum temperature. | State of apricots. |
|-------------|----------------------|-------------------------------|
| 1919. | ° F. | |
| Mar. 1..... | 31 | Buds showing pink. |
| 2..... | 28 | |
| 3..... | 27 | Blossoms opening. |
| 4..... | 29 | |
| 5..... | 19 | 30 per cent of blossoms open. |
| 6..... | 27 | |
| 7..... | 30 | 50 per cent of blossoms open. |
| 8..... | 29 | |
| 9..... | 27 | |
| 10..... | 28 | |
| 11..... | 18 | Trees in full blossom. |
| 12..... | 30 | |
| 13..... | 27 | Petals falling. |
| 14..... | 34 | |
| 15..... | 27 | Petals nearly all off. |
| 16..... | 29 | |
| 17..... | 29 | |
| 18..... | 29 | Fruit swelling. |

On March 25 a thorough examination of the trees at different elevations showed less than 7 per cent of the fruit dead or injured; that is, over 93 per cent of the blossoms were developing sound, uninjured fruit. It is not certain that the dead and injured fruit was due to the cold, as normally, under any conditions, a part die and fall off at this stage of development.

It will be noticed that the blossoms were subjected to daily minimum temperatures below freezing during the entire time that the blossoms were opening, with a temperature 14° below freezing when in full blossom.

The temperature records were made by a Weather Bureau minimum thermometer and a thermograph in a cotton region shelter about 80 yards from the nearest trees. During the period under discussion minimum temperatures 1 inch above the surface of the ground averaged 1.4° F. higher, and, at an elevation of 24 feet, 0.9° F. higher, than in the shelter.

This substation was in charge of the writer, who personally made the observations tabulated above.

NOTES.

There is some discussion of this subject in Bulletin 89 of the New Mexico Agricultural Experiment Station, 1913-14, by F. Garcia and J. W. Rigney, "Hardiness of fruit buds and flowers to frost." Although other observers have shown that 31° is the danger point for peaches and 28° that for apples, there are differences with different stages of growth, the young fruit being the most tender. While 26.5° to 27° is often detrimental to young fruit, 26° is said to be the critical temperature, though 24° sometimes has little effect. The factors of greatest importance are the degree, duration, and time of day of the greatest cold. When the lowest temperature occurs just before sunrise, the effect is worst.

W. H. Chandler, in an extensive contribution, "The killing of plant tissue by low temperature" (Mo. Agr. Exp. Sta., Research Bull. No. 8, December, 1913, pp. 143-309), gives 22° to 25° or 26° as the killing temperature for young peach flowers, and 29° to 30° as that for older ones and young fruit. This work contains a chart showing maximum and minimum temperatures preceding freezing of fruit buds; also, an extensive bibliography. For a general discussion and bibliography of "Frost and the growing season," by W. G. Reed, see Atlas of American Agriculture, advance sheets 2, Part II, section 1, 1918; also, "A selected [annotated] bibliography of frost in the United States," by W. G. Reed and C. L. Feldkamp, Monthly Weather Review, 1915, 43:512-517.